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ELECTRONIC PHOTOFLASH UNITS*

(Continued from last issue)

In use, the firing of the flashtube must usually be synchronized to the opening of the camera shutter. Currently, most new camera shutters are being supplied with built-in contact for such synchronization. These contacts close an external circuit at a definitely established time with respect to the operation of the shutter. The contact points are designed primarily for firing ordinary photoflash lamps in which a small, battery-operated filament ignites a primer which in turn sets off the main charge of aluminum or magnesium shreds. The primer also destroys the filament; thus the contacts of the shutter do not need to break the battery circuit, which in any case ranges from 1½ to a maximum of 4½ volts. Thus the shutter contacts are not designed to have either high-voltage insulation or large current-carrying capacity.

Shutter contacts, when used in a circuit such as that shown in Fig. 6, would probably have a fairly short life, due to the high current and reactive load. For this reason, various types of relay are usually used between the shutter contacts and the spark coil. The flash must take place while the shutter is fully open; the usual shutter contact is made with a setting for "zero lag" in which contact is made by the points when the shutter has reached its maximum aperture.*

* Time lag settings of 5 and 20 milliseconds are also available. Methods of accommodating such delays are discussed later.

Here a relay with minimal time lag is needed, and it usually takes the form of a cold-cathode, arc-relay tube. Thyratron tubes have also been used with equally satisfactory results, but require an additional source of power for the filaments. Relay tube tripping has the advantage of requiring little voltage or current to initiate the arc; the grid leads may therefore be connected directly to the low power-capacity switch contacts on the camera shutter.

The basic circuit using the Sylvania SN-4 Strobotron as a control tube is shown in Fig. 8. The 325-volt d-c supply is obtained either from a separate transformer and rectifier, or from a voltage divider across the main flash capacitor. The 1-mfd capacitor is charged through a 10,000-ohm resistor the purpose of which, again, is to prevent the Strobotron from going into a sustained glow discharge; it also avoids double tripping due to too rapid charging of the 1-mfd condenser. The 200,000-ohm voltage divider, tapped at 25,000 ohms, provides a bias of +40 volts on the shield grid of the Strobotron.

Closing switch S applies a momentary d-c pulse to the control grid of the Strobotron, sufficient to initiate the glow discharge, and discharges the 1-mfd capacitor through the primary of the spark coil. Should the switch remain closed, however, the steady voltage applied to the control grid drops rapidly to less than 2 volts which is not sufficient to initiate a second glow; hence, the tube regains control as soon as the 1-mfd capacitor

In servicing or experimenting with photoflash equipment, it must be remembered at all times that capacitors are charged at high voltages and very dangerous unless extreme care is taken to be sure they are properly discharged before touching terminals or leads.—Editor.

* *By John S. Carroll, in "Electrical Manufacturing."*

Fig. 7—A portable battery-operated photoflash unit and an accessory battery charger.

has discharged. The switch must be opened and the small capacitor permitted to discharge before the tube can again be tripped.

Where the trigger tube circuit secures its power from a separate source, its constants are usually chosen to make its recovery time somewhat less than the charging time of the main flash-tube capacitor. In the smaller power packs, the 325-volt input is obtained from a voltage divider across the main flash-tube capacitor; hence, full voltage is not available until the main capacitor is almost fully charged. In either case, proper firing will not take place, or starting of the flash will be erratic if attempted before recharging of the main capacitor is substantially complete.

An incidental effect, which is in no way dangerous but to some users is annoying, is the noise accompanying the flashing of the tube, especially at high loadings. The noise is apparently due to the sudden release of heat by the flash, which causes a pressure wave within the tube, transmitted through the walls of the tube as sound. At low loadings the noise is trifling and may be compared to the snap accompanying the breaking of a matchstick; with higher power input to the flashtube, the noise may

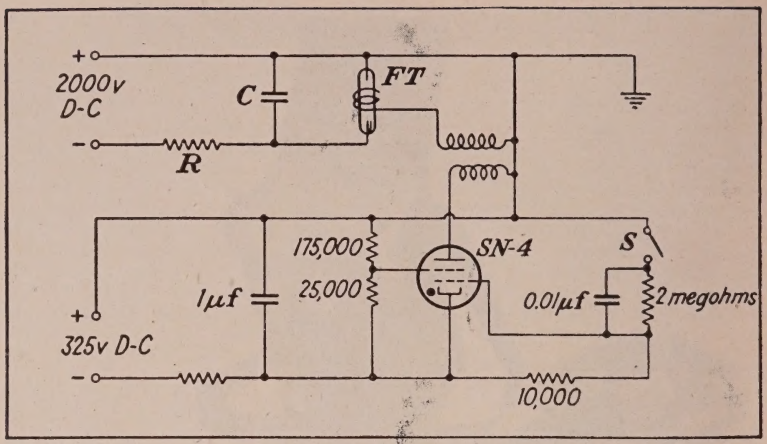


Fig. 8—Use of the Sylvania Strobotron SN-4 as a control tube for operating the flashtube FT. Closing switch S initiates glow discharge in SN-4 and discharge 1-mfd condenser through primary of the spark coil, flashing the flashtube FT.

approach the magnitude of a small rifle or pistol shot.

Some of the noise may be muffled by enclosing the tube; the type 524 (G-E) for example, which was enclosed in an open-ended jacket, is being superseded by the type 503 which is completely enclosed. The sound may also be reduced by reducing the steepness of the discharge wavefront; this may be accomplished by means of an inductance in series with the flashtube.

Power Supply Circuits

The design of the power-supply circuit is, in the main, completely conventional. Full-wave or half-wave rectification may be used, with either high-vacuum, gaseous, or mercury-vapor types of rectifier tube. A typical circuit is shown in Fig. 9. The filament winding of the power transformer carries the high voltage and should, of course, be insulated accordingly. The negative side of the circuit is grounded here; this is conventional, but not universal, as certain methods of triggering require the positive side of the circuit to be grounded (see Fig. 8).

The main flash capacitor is C_2. Its value runs from 25 mfd to 120 and higher, and its working voltage should

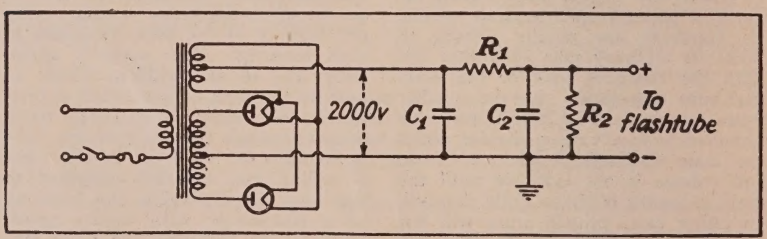


Fig. 9—Typical power supply with full-wave rectification for use with flashtube.

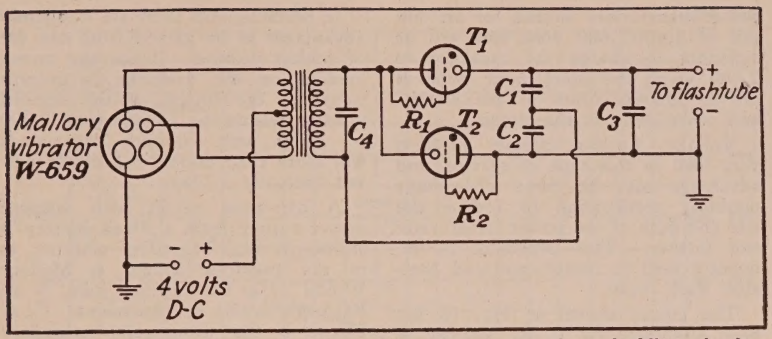


Fig. 10—Use of Raytheon CK-1013 rectifier tubes in a voltage-doubling circuit to obtain a d-c supply for operating a flashtube.

be equal to the peak output of the rectifier.

The charging resistor is at R_1; its purpose and choice has already been discussed. Its ability to reduce power-line surges immediately after flashing is aided by a filter condenser, C_3, usually of about 2-mfd capacitance. R_2 is a bleeder, usually wired directly to the terminals of the main flash capacitor C_2. It is a safety precaution and its value is chosen to dissipate completely the charge on C_2 in anywhere from a few minutes to an hour or more. Longer times are generally chosen where economy of power is desired; shorter times, however, are safer. The optimum value of this resistor is usually somewhere in the range of 1 to 10 megohms. An additional resistor of smaller value is sometimes provided and connected with a safety switch actuated by the removal of the power pack cover, or interlocked with the main power-supply switch. This provides rapid discharging of the capacitor if the pack is to be opened for servicing.

Since the load on the power supply is capacitive, the voltage developed will be nearly equal to the peak value of the rectified d-c output. Thus a

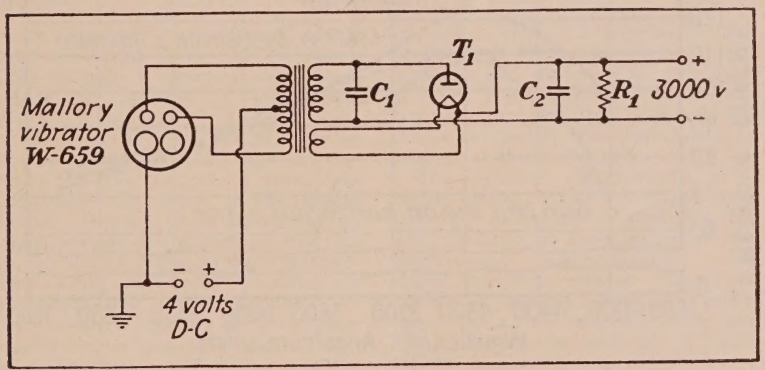


Fig. 11—Obtaining 3000 volts d-c, with which to operate a flashtube, from a 4-volt battery, using a vibrator, transformer, rectifier tube and capacitor.

power transformer wound for an output of 1,400-1,600 volts rms will be sufficient to charge the capacitor to 2,000 volts; the exact value depends on the current drain of the bleeder and other losses in the circuit.

Voltage doubler circuits perform very well in this type of service, and advantage may be taken of voltage doubling rectification to reduce the size and bulk of the power transformer still further. This expedient is frequently used in battery-powered portable flash units.

The circuit shown in Fig. 10 has been suggested by P. R. Mallory & Company for a portable, battery-powered vibrator supply for speedflash use. It uses two Raytheon CK-1013 tubes in a voltage-doubling circuit and, under laboratory test, charged a 25-mfd capacitor in about 6 seconds. It is designed for 4-volt battery operation but the transformer could be wound for 6-volt input if that were considered preferable. C_4 is the transformer secondary buffer, T_1 and T_2 are Raytheon CK-1013 rectifier tubes. R_1 and R_2 are 10 megohms, 1/4 watt each. C_1 and C_2 are 0.25-mfd 1,000-volt working, d-c oil condensers, and C_3 is the main flash capacitor, 25 mfd, 2,000 volts d-c working.

In portable units there are frequently advantages to be gained from the use of higher voltages. Since the power loading on the flashtube is proportional to the square of the applied voltage, raising the voltage from 2,000 to 3,000 with constant capacitance will more than double the power output (actually 2.25x).

A half-wave circuit with vibrator power supply from a 4-volt battery is shown in Fig. 11. The vibrator, as in the previous circuit, is Mallory W-659. T_1, the rectifier tube, is an RCA 8016/1B3 or equivalent. C_1 as before is the transformer secondary buffer, and C_2 the main flash capacitor. The latter may have a capacitance of from 15 to 28 mfd with a working voltage of 3,000 d-c. R_1 is the safety bleeder; its value is 10 megohms at 1 watt. Charging time of a 25-mfd capacitor to 3,000 volts with this unit was 16 sec in laboratory tests.

Flashtube Characteristics

Currently three manufacturers are offering flashtubes for photographic use. Sylvania produces two types, both of which are three-electrode tubes for external ionization triggering. Amglo has five types, four of which are two-electrode types and one, a

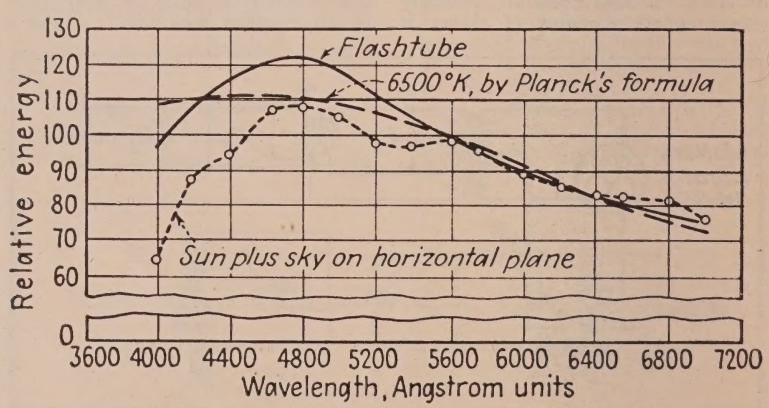


Fig. 12—Spectral energy comparison of flashtubes with daylight, the curve for sun plus sky being from Taylor and Korr, JOSA, vol. 31, No. 1. The graph is from "General Electric Flashtubes," by F. E. Carlson.

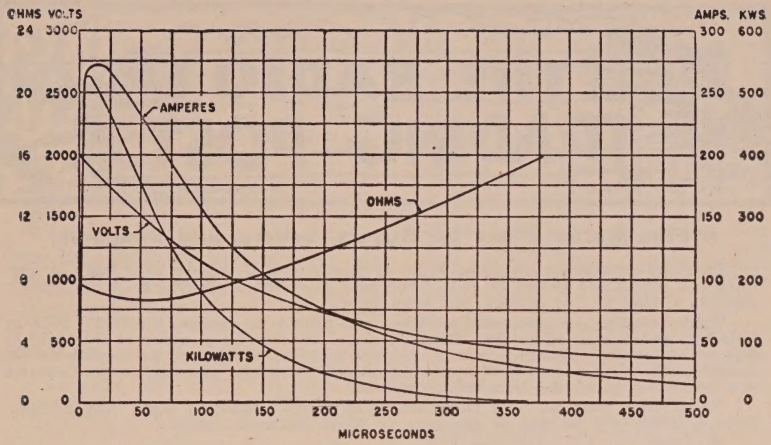


Fig. 13—Performance of a standard small xenon-filled helix flashed from a capacity of 26 mfd, charged to 2000 volts.

three-electrode. G-E during the war produced some 29 different types of flashtube but their line is currently undergoing a simplification and the majority of these types will either be discontinued or supplied as special-order products. Four types, the FT-210, 214, 220, and 403, are now available as standard schedule lamps (see Fig. 1); others may be added to the standard price schedule as demand develops.

All currently manufactured flashtubes are xenon-filled. This produces light having a spectral distribution similar to daylight; a comparative graph is shown in Fig. 12. The excess of short-wavelength energy emitted can be compensated for color photography by the use of a very light minus-blue filter such as the Kodak CC-13. Warmer tones are secured by using heavier filters such as the CC-14 or CC-15. For rapid, repetitive-flash work, other gas mixtures are sometimes used. Argon-hydrogen filling enables a tube to de-ionize more rapidly and is frequently used at rates of 1,000 flashes per second or less. The blue color of the light emitted is useful only for black-and-white photography. At flashing rates above 1,000 per second, even these tubes tend to become continuously conducting, and a Capacitron (mercury switch tube) must be used in series with the flashtube.

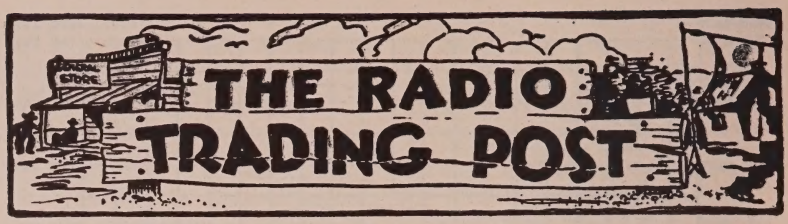
The energy input to a flashtube is expressed with reasonable accuracy by the formula

$$\text{Watt-seconds} = \frac{CE^2}{2}$$

where C is in microfarads and E in kilovolts. Thus, for example, a tube operating at 2,000 volts and 112 mfd consumes 224 watt-seconds, very nearly . The approximation is due to the fact that the capacitor does not discharge completely, the tube ceasing to conduct at about 150 volts.

The dynamic characteristics of a typical helical tube at a relatively light loading is shown in the graph, Fig. 13. The similarity of these curves to the conventional resistor-capacitor discharge curves is evident. The tube exhibits a negative resistance characteristic during the first part of the discharge cycle as the ionization is building up in the tube; as the discharge continues, the resistance increases dur-

(Continued on page 15)



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FOR SALE—Speco signal tracer amplifier with probe. Used only three or four times. Just purchased recently and is in perfect shape. I have no need for it. Joseph Truce, Aurora, Ohio.

WANTED—A good dynamic mike and will trade a .22 Mosburg rifle for it, in A1 shape, 16 shots, belt action. Also want one or two speaker projectors with PM units. John Arnold, Box 84, Bluffs, Ill.

FOR SALE—2 RCA heavy duty turntables, ac, University 24" trumpet only, 50 watt Lafayette amplifier, Shure dynamic mike, 2 Jensen dynamic trumpets, PM. Ed Monahan, Shawomet, R. I.

WANTED—Legal size rotary duplicator. Cash or trade. Eddie Howell, 501 West Harden, Graham, N. C.

FOR SALE OR SWAP—3 tube amplifier using 12SQ7, 50L6 and 3525, completely wired with tubes, $9. Telescope 20x30 field, 65 mm diameter of objective, $45. Or will swap for latest tube and set tester, or what have you. Xavier Curio, 4430 DeReimer Ave., Bronx 66, N. Y.

WANTED—All radio items, old test equipment, test panels, meters, push button allocators, speakers, tubes, any instruments. Buy or trade anything in radio. Have on hand parts, service shop equipment, for sale as a lot. Warren Wigner, Gen. Del., Ft. Wayne, Ind.

WANTED—Radio control box, BC-450-A, complete, and instruction book for SCR-274-N; also 6-12 volt Signal Corps battery charger. John A. Seaman, Gentry, Ark.

SWAP—Rider's Manuals, volumes I to VIII inclusive. Condition like new, with index. Want good 8 degree table saw with tilt arbor, or Garrard changer in good condition. G. Sullivan, Box 11, Albertson, N. Y.

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FOR SALE—A number of popular radio and electrical books, slightly used. Send for list. S. S. Schlissel, Box 10, Kingsbridge Station, New York 63, N. Y.

FOR SALE—Supreme set analyzer, model 550, in excellent condition, $37. Also a new Solar capacitor analyzer, CE-160, $52. Tony Zucco, 3rd St., Cresson, Pa.

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WANTED — Mimeograph, Sparx analyzer or 8 mm projector. Have for trade scotch tape (in quantity), tubes and gift items, including music boxes and music works. William J. Wax, 527 Bedford Ave., Brooklyn 11, N. Y.

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WANTED — 32v dc to 110v ac inverter. Also 32 volt generators, radios, etc. Harry Matzke, New Auburn, Wis.

FOR SALE—One 1210N Triplett life time meter tube tester in perfect condition, with instruction sheet, ready to use. A bargain for anyone needing a tester. First $15 gets it. Arch G. Newbern, Bremen, Ga.

TRADE—BC-223 transmitter, 75 phone, 80 cw with ac power supply and BC-284 mobile 75-80 meters, 6v, on BC610 or commercial transmitter. Sell CB160 Solar capacitor analyzer, $29; multimeter, $15; radio course, late NRI complete, $100. Want good camera and Rider's manuals. K. H. Stello, 12026 Peoria St., Roscoe, Calif.

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FOR SALE—Stancor 60-N transmitter, complete with tubes, meter, and factory coils for four different amateur bands. Price $100 cash. Helen M. Douglas, 1501 Monroe St., Commerce, Tex.

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SWAP—Movie projectors, 8, 9½, 16 and 35 mm; auto and home radios; rotary converters; RCA Radio Service course; QST, Popular Science, Popular Photography, Life and other magazines; Rider manuals; many other items. Want garden tractor, gas engine, 35 mm still camera, movie camera, test equipment, sewing machine. Joseph Leeb, 1380 Merriam Ave., Bronx 52, N. Y.

FOR SALE—One RCA audio chanalyst, 170-A, used very little, in excellent condition, value $345. Will sell for $285. Address mail to Manuel Rubio, Cuscaden Park Supply Co., 3002 15th St., Tampa 5, Fla.

FOR SALE—All new radio parts, tubes, miscellaneous. Clarence W. Hull, Rt. 1, Box 385A, Fair Oaks, Calif.

FOR SALE OR TRADE—NRI course, complete with experiment manuals and experiment equipment. Prefer to trade for photo equipment. Best offer. J. P. Epps, Box 409, Lawrence, Kan.

POSITION WANTED—Young man, 25, college grad., 6 years experience in the repair of instruments and radios, fluent knowledge of Spanish, Italian and French, also office experience, acquainted with export procedures, wishes to work in export department of electronic firm. Henry Amistade, 124 Sterling St., Brooklyn 25, N. Y.

FOR SALE OR SWAP—Have No. 19 Mark II receiver and transmitter set. Will swap for a new WRL Globe Trotter transmitter including coils and crystals. Or will sell to highest bidder. J. A. Aller, 322 S. Pine St., Lakemont, Altoona, Pa.

FOR SALE OR SWAP—Huttig Atom model 51 made by ICA Aktiengesellschaft, Dresden-A, takes 127 film pack 1⅝" by 2½" negatives. Compur shutter automatic for time and bulb exposures as well as instantaneous 1-25, 1-50, 1-100, etc. F6.8 Huttig anastigmat doppelt lens. Folding camera, $15. I. Allen Hanover, 47 Bay 26th St., Brooklyn 14, N. Y.

FOR SALE—110 volt 60 cycle selsyns, $3.25 a pair; 110 volt 60 cycle selsyn differentials, $1.05 each. New Speed-X bugs less weights, $4.75; Navy model YG246 mc transmitter, $85. B. Bernbaum, 5746 N. Park Ave., Philadelphia 41, Pa.

FOR SALE—Philco test bench consisting of RF signal generator (recently recalibrated at factory), audio signal generator, volt-ohm-milliammeter-VTVM, tube tester, oscilloscope, test speaker, vibrator tester, work bench and storage space. All in one unit. Make me an offer. No reasonable offer rejected, all inquiries answered. Kenneth Ballard, Mason City, Ill.

FOR TRADE — Confidence special tube tester. Can be modernized to test octal and loctal tubes. Have 50 lessons of NRI course, power pack, 110v ac to 2v dc, 112-135 voc. Want Federal enlarger, 8 or 16 mm movie camera, or what have you. Paul B. Long, Carthage, Miss.

FOR SALE — New tubes, VR-105 and VR-150, 9000 series, 6C4, Acorn series, 75 cents each; 807, 90 cents; 211, $1.75; 814, $4.20. RA-20 ac power supply for BC-312, $10.95; RCA 100 kc crystal standards, $4. M. Fisher, 1328 Courtland St., Philadelphia 40, Pa.

FOR SALE—200 articles of ham equipment at lower than wholesale cost. Tubes, xtals, xformers meters, books, some new, some used, all good. Stamp for list. All letters answered. Want movie equipment, films. Warren Gilman, Winter St., Tilton, N. H.

FOR SALE—Dumont 224A 'scope, cost $235 one year ago, $125; Espey lab oscillator, 5 ranges to 32mc, $30; Queens Wheatstone Bridge accuracy 1-10 of 1%, $35; Espey vacuum tube voltmeter, 30 meg. input, $35; Weston model 45 mirror scale meter, 0-1½ ma dc, accuracy 1-10 of 1%; Graflex 3A reflex camera, 9" B & L 4.5 lens, $30; assorted Weston, GE and Westinghouse panel meters. Will purchase good mandolin or late model portable Royal typewriter. Gus Jacobson, Room 806, 395 Broadway, New York 13, N. Y.

WANTED—Old issues of Modern Electrics, Popular Electricity, QST 1919 and 1920. Cash or will swap extra old issues. John T. Lipani, 157 Leverett St., Boston 14, Mass.

FOR SALE—Latest model RCA voltohmist, model 195A. Perfect condition. Used only a few months. Price $58.50. Greenen Radio Service, 518 Liberty St., Aurora, Ill.

FOR SALE — 350 tubes, phono pickups, record players, electric radios, battery sets, speakers, aerial kits, auto aerials, Rider's manuals, 11, 12, 14. Also miscellaneous stock of repair parts. A complete radio shop. Will sell part or all. Stock cost $1100 wholesale, will take $800 for all. Send for list or what you need. Atlantic Radio Service, Atlantic, N. C.

FOR SALE — Weston meters type 301. Transmitting condensers, tubes, transformers, and other supplies. Also have one Collins transmitter, 3-A at $175. Also hundreds of other radio items for sale. Write for list. Leo F. Kersey, White Sulphur Springs, W. Va.

FOR SALE—Lafayette model 263, 35 watt amplifier, 8 tubes, 2 12" Magnavox dynamic speakers. Like new, 2 mike and 2 phono input separate taps for PM speakers, $125. 16 mm Bell and Howell silent projector, like new, with extra lens and lamp, $175. Model 920P Precision tube checker and VOM, new, $80. Precision signal generator, new, $60. M. J. Difini, 1698 Lexington Ave., New York 29, N. Y.

WANTED—1 set 4 copper oxide rectifier discs, GE LB-530. State price, new or used. Will sell 10 tube Motorola Golden Voice in good condition. Best offer takes it. McCalla Bros, Grove City, Pa.

FOR SALE—1935 Plymouth 4 door with radio and heater. Repairs to car in past 6 months, motor job, brakes relined, new rear end, ignition rewired, new spark coil, four new tires, new roof. Car perfect condition. Reason for selling, buying new station wagon. E. Watson and Son, 683 Washington Ave., Brooklyn 16, N. Y.

FOR SALE — 100 assorted QST, Radio News, Electronics, back issue magazines dating from 1942 to 1946 for sale. Address offers to W. Richman, 3438 90th St., Jackson Hts., Long Island, N. Y.

FOR SALE — Supreme Vedolyzer, model 560, in excellent condition. Cost over $150, will sell for $50. Will guarantee service on equipment for year. Joseph Seranfinko, 59-46 57th Rd., Maspeth, Long Island, N. Y.

FOR SALE—New test equipment. Hickok 305 'scope, $125; 191X signal generator, $110; 125 VTVM, $80. Precision E-200 signal generator, $54; EV-10-P VTVM, $60. Rider manuals VI, $9; VIII, IX, XI, and XII, $12.50 each. Express paid to destination. John G. Rader, 704 Walnut St., Reading, Pa.

WANTED—Part time position. Vet radio student offers services four hours Saturdays in exchange for genuine opportunity to learn practical radio servicing. Charles Stubbs, 805 Quincy St., Brooklyn 21, N. Y.

FOR SALE—Scott Sixteen custom built all wave receiver console. Tubes are excellent. Separate tone controls, 2 speakers in one. Worth over $275. Asking a very reasonable price, $90 as is. Arthur J. Cherpoff, 160 Bay 28th St., Brooklyn 14, N. Y.

FOR SALE—Army surplus parts and tubes. 393A, 1619, 350B tubes. Also high voltage transformers and heavy duty chokes and meters. Send for list and specs. Vitale's Radio Servicing, 194 Barney St., Wilkes-Barre, Pa.

FOR SALE—S20R receiver like new, magic eye installed, also VR tube, $55 postage paid. Money order only. Need money for school. J. D. Gallagher, Box 4562, College Station, Tex.

SELL—New HQ 129X receiver with 11" matching speaker. Holstein, 246 E. 148th St., Bronx, N. Y.

FOR SALE—Used ac radios, ac-dc radios, ac power transformers, 250v 6.3, and many other items. Please forward stamp for list. Louis A. Goldstone, 1279 Sheridan Ave., Bronx 56, N. Y.

WANTED — Your radio diagrams, snapshots, cards and papers to be permanentized. Sealed under airtight plastic, crystal clear, no curling, discoloration or bending. Will not scratch. 5 cents a square inch. Minimum 75 cents. L. R. Van Sickle, 2915 Allen Ave., St. Louis 4, Mo.

WANTED—Rider's manuals 1 to 14. Also any make multimeter. E. Vockeroth, 1746 N. Campbell, Chicago 47, Ill.

FOR SALE—One National PW 4 gang precision condenser; 20 National plug in coil forms XR-39M; 4 coil cans. All above are new, never been used. F. E. Theobald, 357 E. Sheridan Ave., Dayton 3, Ohio..

SELL OR TRADE—1947 DeForest's radio course, complete; RCP model 650 signal generator; Supreme model 599 combination tube and set tester; Dumont model 274 5" oscilloscope; 5BP1 and 5LP1 cathode ray tubes; miscellaneous radio parts. Want good communications receiver, typewriter, target pistol, .22 rifle, automatic, and automatic record player, and-or recorder. Also good course in accounting. All mail answered. John F. Raposa, Jr., 167 Washington St., Fall River, Mass.

WANTED—Abbott TR42 meters, transceiver or what have you. Will trade 2 bank and turn indicators; one tachometer; 1 artificial horizon airplane instruments. Need front glass. Will answer all replies and sent for inspection. C. J. Fritz, 2824 E St., Liberty Boro, McKeesport, Pa.

TRADE—Complete N.R.I. radio course, 4 years old, in almost perfect condition. I would like a movie projector. Kenneth Aderborg, 3746 N. Olcott Ave., Chicago 34, Ill.

WANTED—Used Stancor deluxe model 133 dc power pack. Paul W. Curtis, 1003 Warren Ct., Richland, Wash.

WANTED—Hickok tube tester, model 510 or 532. Counter or portable type. In good condition or inoperative. Also Rider's manuals 2, 3, 4, 5. Cash. Leonard Peak, 1920 N. Spaulding, Chicago 47, Ill.

FOR SALE—Motorola auto radio, A1 condition, $25, or will swap for tubes. All letters answered. Michael Roman, 208 Goundry St., N. Tonawanda, N. Y.

FOR SALE—Supreme 504-A set and tube tester, 1946 model, cost $89.50, used 2 months, will sell for $75. 24 Cainer 3½ ft. metal outdoor trumpets, new $27.50, will sell for $12 each. 24 PM driver units, 25 watts, new, look like Racon units, have no name, Army surplus, will sell for $20 each. Roy H. Cressman, 334 W. Marshall St., Norristown, Pa.

WANTED—Recorder, home record type. Will trade radio parts or pay cash. Please give full description and price. Hein Radio Service, 418 Gregory, Rockford, Ill.

WANTED—Second hand receiver, model EC-1A or S-41. Will pay cash. Stathis Linardos, 190 Wadsworth Ave., New York 33, N. Y.

WANTED—New or used tube capacitor tester, in a hurry for same. Will pay cash. G. E. Eggleston, Box 18, Geneva, Minn.

WANTED—32L7GTG tube. State condition and price wanted. Hugh Gregg, 1424 Workman Mill Rd., Whittier, Calif.

POSITION WANTED—Young man, 20, ambitious, 1½ years college experience in radio, teletype, receiving equipment, maintenance, sales(food), radio assembly. Interested in job as trainee in administration or sales work in New York. Fred S. Fagenson, 115 Central Park W., New York, N. Y.

FOR SALE—Ford Philco 1937 auto radio with tuning head, $22.50. Coronado 5 tube midget radio with push buttons, $8.50. Hard to get tubes 10% off list prices. H. A. Fischer, 1510 Washington St., Wisconsin Rapids, Wis.

SWAP—Home made bug key lead base factory made bar, used for CW 2 years. Want headphones or 2 tube short wave battery receiver. Fred Allen, 719 Cleveland Ave., Michigan City, Ind.

TRADE—N.R.I. portable combination signal generator, volt-ohm-milliampere, made by Triplett. Used only once. Perfect condition with book of instructions and test leads, for 25 or 30 watt amplifier with tubes. If there is any difference, will pay in cash. H. Andresen, 3317 N. Albany Ave., Chicago 18, Ill.

POSITION WANTED—Melville Radio Institute and AAF trained. Television, radar, first class phone license. Some college education. Anxious to get started. S. Altmann, 1110 College Ave., New York 56, N. Y.

FOR SALE OR TRADE—Hewlitt Packard signal generator, has input and output DB meters, A1 condition. Also Underwood typewriter. Am interested in rf signal generator, oscilloscope, camera, or photographic equipment. All letters answered. I. Silbermintz, 2416½ Malabar St., Los Angeles 33, Calif.

SELL OR SWAP—A railway telegraph Morse code course, like new, $10. P. Mayert, Revelstohe, B. C.

FOR SALE—New model 650 signal generator, $40; new model 450 tube tester, $30; new model CA11 signal tracer, $12; 25 watt amplifier with phono attachment, 2 speakers, mike and stand, and horn, $100. K. H. Logan, 13 Water St., Northfield, Vt.

FOR SALE—Collet attachment for South Bend lathe, 4 collets ¼", 7/32", 3/8", ½", carriage stop, 2 lathe centers, 3 tool holders, takes ¼" tool bit, Jacobes chuck ½" capacity, ball bearing center. $40 takes all. M. Pearlman, c-o Mackless Radio, 2246 Ocean Ave., Brooklyn 29, N. Y.

WANTED—Car radio for a 1941-6 DeSoto, custom built for a DeSoto, single unit type. For sale, tubes 7C5, 75 cents; 7F7, $1. Debased for high frequency applications. Can be used as normal replacements. Martin Storma, 7933 Hillcrest Dr., Wauwatosa 13, Wis.

WANTED — A used Teleplex, Instructograph, or Gardener-Levering code practice set. J. C. McDermott, 5761 Roosevelt Place, St. Louis 20, Mo.

FOR SALE—GE, Sylvania, RCA tubes in original cartons on most scarce types. Any quantity 50% up. Also industrial type tubes. John Magnus, 9415 So. 55th Ave., Oak Lawn, Ill.

FOR SALE OR TRADE—NRI radio correspondence course, 65 lessons. Would like a communications receiver in any condition. C. A. Kuhns, 3132 Broadway, San Diego, Calif.

FOR SALE OR TRADE—Wilcox-Gay wireless phonograph. Many tubes and parts to swap. Best offer takes a new HQ-129X complete with speaker. Will take a BC342 or BC348 war surplus as part payment. Will sell 10 watt eco in good condition to highest bidder or for what have you. WQEER, Box 97, Dresbach, Minn.

WANTED—Will pay cash for mimeograph or duplicator machine. State model, condition and price in first letter. All correspondence acknowledged immediately. J. and C. Radiolabs, c-o C. H. Cote, 111 Woodlawn Circle, E. Hartford, Conn.

FOR SALE—RCA Rider chanalyst, model 162-C, like new, 20% off new price. Silver Vomax, model 900, A1, $54. C-D capacitor bridge, model BN, perfect, $10. Detect-O-Ray photo electric switch, model L-162, new, $15. Masco 3 tube amplifier, A-1, $12. Earl H. Stevens, Rt. 1, Bourbonnais, Ill.

SWAP OR SELL—"C" melody saxophone with case for portable typewriter or radio testing equipment. Also want tube type 25B8. Will pay cash for tube. Ernest Cook, South Fallsburg, N. Y.

POSITION WANTED—High school graduate, member NRI. 1 year experience in radio service and sales. Prefer position in Eastern New York. John Cox, Jr., RFD 1, Box 28, Saugerties, N. Y.

FOR SALE—Oscilloscope, Rider's manuals, meters (micro A to amps.), signal generator, speakers, trans., tubes, phones, and miscellaneous equipment of all kinds. Also servicing data of value to you. R. J. Clark, 902 So. Newbridge Rd., Bellmore, L. I., N. Y.

FOR SALE—New model CE Solas capacitor analyzer, $45; Stancor A power pack, new condition, $35. Want a complete bulkhead speaker with case and cables, and plug for a model 70 Motorola auto radio. Paul Capito, 637 W. 21 St., Erie, Pa.

FOR SALE—Navy TBX-8 transmitter and receiver. Receiver tunes from 2 to 8 megacycles, transmitter, 2 to 5-8 megacycle, power output CW 9 watts, voice 3 watts. Complete with tubes, cables, dynamotor and instruction book, $30. M. Greenberg, 241 Bristol St., Brooklyn 12, N. Y.

WANTED—Back copies of the Capacitor up to Nov. 1946; also Feb., Mar., Sept., Oct. 1946 Radio Maintenance magazine. State condition and price. All letters answered. T. Jon Gibbs, Westport, Ore.

TRADE—Radio books, coil wire, speaker, resistors, switches, and Verneir dial. All are new, to be sold as lot. Will trade for United States stamp collection. Send for list. Fred Arno, Rt. 4, Dexter, Maine.

SELL OR TRADE—Western Electric signal generator, 50-110 mc, $35. BC406 15 tube receiver, $20. 6 tube aircraft receivers, $6. Emerson 1/8 hp motor, 1140 rpm, single phase, $15. Tweeter, $6. A. J. Gerel, 278 E. Columbia St., Hempstead, N. Y.

FOR SALE—Superior PB200 push button operated VOM, Superior 450 tube tester, Weston 785 electronic tester (20,000 ohms-volts), Weston 689-IF low range ohmmeter and carrying case. Above instruments include test leads and instructions, all in perfect condition. Also 200 resistors in various sizes, and approximately 50 new bypass condensers. Also radio books and DeForest's training course. Write for complete list. Greene Radio Service, 21201 Audette Ave., Dearborn, Mich.

FOR SALE—New radio tubes in cartons. Send for complete list and prices. High-Tor Radio, Haverstraw, N. Y.

SELL OR TRADE—Triumph 351 multimeters, 12 volt and 110 volt, 100 watt American Beauty soldering irons, 100-455 kc transformers. Most all types of tubes, radio parts, and tools. G. F. Roby, 1119 Milwaukee Ave., Chicago 22, Ill.

FOR SALE—Superior signal tracer, model CA-11, cost $18.75, used once, will sell for $14.00. Barrett's Radio Service, 981 Smith St., Trenton 10, N. J.

FOR SALE—Meissner signal spotter, late 41 with two sets of coils for 80 and 40 meters. Absolute match for deluxe signal shifter. Best offer takes it. R. B. Parker, Box 395, Harwichport, Mass.

FOR SALE—Meissner 14 tube Traffic Master, partially wired, less cabinet, $65. Webster deluxe record changer and recorder. Plays 17 10" and 12" mixed. 1¼ oz. pickup, perm. needle, new, $75. J. W. Bourke, Box 35, East Rockaway, N. Y.

FOR SALE—Triumph multimeter, model 333S, mirrored back, metal case, measures ac-dc voltage, output voltage, decibels, amperes, and up to 10 meg., up to 100 meg., with external battery. Test prods included. Price $28. Harold Ehrlich, 2951 W. 25th St., Brooklyn 24, N. Y.

FOR SALE—Wired power pack, 6⅛" by 9" by 3½", 390v-140 mil., 2 6v filaments. Uses two C-D 16 mfd 450v can filters and two 6x5's, with ceramic mtg. strip. Special $5.95; with tubes $7.65. Conservatively rated. Bargain. A. DiGiovanni, 1921 Belmont Ave., Chicago 13, Ill.

SWAP ONLY—Remington portable typewriter, like new. Need urgently small used ham receiver as NC44, NC45, FB7A, FBXA. Howards, Hallicrafters, etc. Please, fellow hams. Bud Woida, 2315 Monroe St., Two Rivers, Wis.

FOR SALE—RME-45 Calomatic, 5 months old, $155; RME-45 cabinet, $10; other odd parts such as a meter, mike, cond., and dials. Richard Rice, 406 W. Oregon, Urbana, Ill.

FOR SALE—3 tube ac-dc phono amplifiers, new, with tubes, less speaker, $5.50; 7x50 Zeiss field glasses, heavy metal, $100; Popular Science, 10 cents each; Popular Mechanics, 15 cents each; Triplett 1210A tube tester, $12.50 F.O.B. T. Wojciechowski, 2837 Fulton St., Brooklyn 7, N. Y.

FOR SALE—Brand new Army Aircraft transmitter, BC-375E. Rated 100 watts, output, voice, mcw or cw. Complete with tuning units, $29.50. F. O. B. E. A. Anderson, 427 So. Alexandria, Los Angeles 5, Calif.

FOR SALE—Excellent 6 volt dc, 115 volt ac, 20 watt amplifier with phono top. Tested but not used, $75. For technical data, write to E. St. Arnauld, 24 Arch St., Meriden, Conn.

WANTED — Condenser tester (cap-resistance bridge), any make, in good condition. Must be reasonable. Also will buy table model radios in cabinets, any condition, will pay cash. Your Radio Doctor, 397 Melrose St., Brooklyn 6, N. Y.

FOR SALE—Weston equipment, 1 volt ohmmeter, model 663, 1 analyzer, model 660, 1 oscillator, model 662. Meters were recently overhauled by the Weston engineers. What am I offered? Victor Radio Service, 63 Oak St., New Britain, Conn.

FOR SALE—General Electric CRO-5A oscilloscope, perfect condition, price $125. Measurements 78B signal generator, 15-25 mc and 140-225 mc, all tubes except 7C5, price $25. Oscar E. Carlson, 94 Trenton Ave., Clifton, N. J.

FOR SALE—National NC-100-ASD 10 tube receiver, 200-400 kc, 1300-30 mc in 5 bands. S meter, noise limiter. Matching speaker case with Jensen 8" PM. Spare parts consisting of 20 tubes. Very slightly used. $80. R. C. Hansen, 316 E. 12th St., Rolla, Mo.

FOR SALE—50 watt amplifier (Masco). 2 25 watt University horns. Turner 999 microphone with shielded cable, 2 50 foot amplifier to horn cables, will sell complete. Still in original cartons. Never used. Martin Electronics, 142 Ralph Ave., Brooklyn 33, N. Y.

SALE OR SWAP—Leeds and Northrup, Wheatstone Bridge, model 5300, complete with galvanometer, like new, want 10 meter transmitter or other gear. Carl H. Harp, Box 242, Crescent, Okla.

FOR SALE OR TRADE—Rubber stamps. 3 line cushion, index, not over 2" long, 70 cents, or trade for anything to help a beginning radio serviceman. Prices on longer stamps and details 3 cent stamp. T. Cookson, Box 40, Puxico, Mo.

FOR SALE—Astatic crystal pickups, 5" P.M. speakers and transformers, Recotone crystal needles, phono motors and discs, 50 x 30 at 150v condensers, tubes (Sylvania and Hytron), 1/4 hp 1 phase ac motors, 1/3 and 2 hp 3 phase ac motors. Approximately 60% off. Write for information. R. Manning, 1 74th St., Brooklyn 9, N. Y.

WANTED—BC-610 or other. Have radio parts. Sell or trade. Eddie Howell, 501 W. Harden St., Graham, N. C.

ELECTRONIC PHOTOFLASH UNITS

(Continued from page 7)

ing the remainder of the cycle. For an extended discussion of the implications of these curves, the reader is referred to the original papers listed in the bibliography.

The light output per flash is a function of the energy input and the efficiency of the flash in lumens per watt. Data on the efficiency of flashtubes is scanty at present; with G-E flashtubes working in the vicinity of recommended loadings, efficiencies of the order of 30-50 lumens per watt are obtained. The efficiency drops as voltage or capacitance is reduced.

Tube efficiency is also related to the gas-filling pressure. The most efficient tubes on the market are filled at pressures approaching atmospheric; manufacturing difficulties in connection with filling tubes at pressures above 1 atmosphere seem to limit the possibility of further increases in efficiency in this direction.

(This article will be continued in the next issue.)

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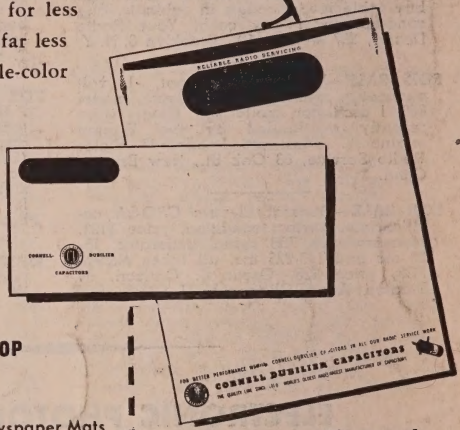

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